

Recycling Aluminum Cans Makes Cents!

Summary:

Students determine which common materials are recyclable, calculate the potential value of aluminum cans in the recycling market and analyze the recycling rate of Virginia communities.

Objectives:

Students will ...

1. be able to list several benefits of recycling aluminum cans to the organization (doing the collecting) as well as the environment.
2. understand that recycling rates are affected by a variety of logistical and economic factors.
3. learn how their own community's recycling status compares to the rest of the state.

Background Information:

The statistics are staggering! The U.S. leads the world in the production of **municipal solid waste**. Even compared to other industrialized nations, we generate twice as much solid waste per person. Today, the average American produces nearly 4.8 pounds of **trash** per day, about twice as much as was generated per person in 1960.

Yet, within the myriad of current environmental issues, reducing the amount of trash he or she generates could be the most tangible positive action a young person can take. Similarly, examining the **"life cycle"** of commonly discarded items and weighing the choices communities make concerning their disposal, exposes students to the inter-relationship of the **free market system** and more responsible management of natural resources. With the present economic situation and its lower **commodity** prices, recycling advocates will need to be well versed in all of its benefits.

During their elementary experience, students should have been introduced to the "Three Rs" of solid waste management – **Reduce, Reuse and Recycle**. The order of these activities is not random. They are typically listed in the order of efficiency. Reducing waste by utilizing the by-product of a manufacturing process or choosing to eat an apple instead of applesauce in a small plastic container, are relatively inexpensive ways to conserve resources. Students may be familiar with the old saying "An ounce of prevention is better than a pound of cure." Reusing materials that would otherwise be thrown away lessens (at least in the short term) the volume of waste that needs to be collected, transported and buried in a **landfill**. Examples would be reusing storage containers and donating used clothing to Thrift stores. Recycling, while important, is not as efficient as reducing and reusing. The re-processing of goods uses energy, water and other raw materials. For it to be successful, the cycle must be completed through the purchase and use of the new product that was made from the recycled materials.

When an aluminum can is recycled it can hit the shelf as a new container in as little as 60 days. At 8% of the earth's crust, aluminum is the third most abundant element in nature and the most widely used non-**ferrous** metal. It is used extensively in cars, airplanes, boats and other vehicles because of its light weight, strength and resistance to corrosion. Since it doesn't react with food and chills quickly, it is also a popular beverage container. Americans drink an average of 370 beverages per person in aluminum cans each year. Approximately 50% of them are recycled. This relatively high rate can be attributed to the properties of aluminum itself and the monetary value. Aluminum can be rolled, squeezed and cut in to almost any shape. It can be recycled over and over again without losing its strength. The high value of aluminum scrap is a key incentive and for recycling.

Beverage containers represent less than 20% of the materials collected in curbside recycling programs, but they generate up to 70% of the total scrap value. According to the Can Manufacturers





Institute, aluminum is the only packaging material that not only covers the cost of collecting and re-processing itself, but subsidizes the recycling of other containers made of glass and plastic. Nationwide, individuals, organizations and local governments earn about \$1 billion a year recycling aluminum cans. Global aluminum recycling rates are high as well.

Aluminum recycling benefits the environment and future generations by saving an estimated 95% of the energy required for aluminum production from ore, thus greatly reducing air emissions including **greenhouse gases**. Alumina, the raw material for primary aluminum production, is extracted from bauxite. For every pound of aluminum recycled, four pounds of bauxite are conserved. Over 50 million pounds of aluminum cans are recycled every week. All recycling efforts save critical space in landfills.

In Virginia, the State Legislature has established recycling goals for local municipalities (counties and cities) as a part of their Solid Waste Management Plans. In their Solid Waste Management Plans, localities must consider how much waste is being generated, collected, transported, stored and disposed of and how these operations may be improved. In many cases, the plans are developed and implemented on a regional basis through a Solid Waste Planning Unit (SWPU).

Local recycling programs which are included in most Solid Waste Management Plans, focus on the collection of recyclable materials, and then marketing (selling) them through a public or private processing or brokering system. Types of collection systems include drop-off containers, more elaborate convenience centers at transfer stations or other locations and curbside pick-up programs. In Virginia, recyclable materials from the municipal solid waste streams include: paper (newspapers, corrugated cardboard, high grade office paper, mixed paper,) metal (ferrous scrap, non-ferrous scrap, aluminum, tin cans) certain plastics, glass, waste tires, used oil, oil filters and construction waste. Each SWPU is mandated to achieve a minimum recycling rate of 25% (of the total volume of recyclable entering the waste stream). If the locality (or region) has a population density less than 100 people per square mile or an unemployment rate 50% or more above the state average, the recycling goal is a minimum of 15%. The State of Virginia provides incentives to localities such as recycling equipment tax credits, waste tire end-user reimbursements, non-competitive grants and supports a Virginia Recycling Markets Development Council.

Despite recent increases in the recycling rate, Virginia, at 38.5% in 2007, remains below the national average of 45%. The presence of **bottle bills** in states with large populations such as California, New York and Michigan positively impacts the national recycling statistics.

Environmental Science Vocabulary Words:

Solid Waste All solid waste including trash, garbage, yard waste, ashes, industrial waste, demolition and construction waste and household discards such as appliances, furniture and equipment.

Trash Material considered worthless, unnecessary or offensive that is usually thrown away. Trash is generally defined as dry material and excludes food waste (garbage) and ashes. However, the term is often used interchangeably with “garbage.”

Product Life Cycle A marketing theory in which products go through a sequence of stages from introduction to withdraw from the market (also called cradle to grave.) In regards to environmental management, the stages are studied in terms of how the product’s life cycle impacts natural resources. Material extraction, processing, manufacturing, use, waste management and potential re-use, re-manufacture and recycling are all considered.

Free Market Is a theoretical term that economists use to describe a market that operates independently of the government, military or other coercive power. In a free market system, buyers and sellers voluntarily exchange money for goods or services at an agreed upon price.

Commodity A product that is the same no matter who produces it and for which the price is relatively uniform throughout the market. In addition to ore, minerals and scrap metal, examples include petroleum and agricultural products such as soybeans, corn and milk.

Reduce To lessen in extent, amount, number or other quantity. In terms of solid waste management, reducing can involve limiting the use of certain products that are considered undesirable, that often become trash.

Reuse To extend the life of an item by using it again, repairing or modifying it or creating new uses for it.

Recycle The collection and reprocessing of manufactured materials for remanufacture either in the same form or as part of a different product.

(Sanitary) Landfill A specially engineered site for disposing of solid waste on land. Constructed in a way that reduces hazards to health and safety.

Ferrous Derived from iron ore.

Greenhouse Gases Gases in the earth’s atmosphere that absorb and re-emit infrared and radiation including carbon dioxide, methane, nitrous oxide, ozone and hydrofluorocarbons. In excess, they are believed to contribute to the “Greenhouse Effect” and global climate change.

Solid Waste Management The controlling, handling and disposal of all solid waste. One goal of solid waste management is to reduce waste to a minimum.

Bottle Bill A container deposit law that requires a minimum refundable deposit on most beverage containers, to ensure a high rate of recycling or reuse. Michigan, which has one the largest deposits per container, has an average recycling rate of 90% or about double the national average.

Supplies:

- Internet Access
- Student Worksheets – “Can It Be Recycled?” Aluminum Can Dollars and Cents and Virginia Recycling Rate Report
- Optional – Poster Board, markers, scissors, glue sticks, etc. for making product life cycle posters

Procedure:

1. Use Background Information to review with students the important role of recycling in a local solid waste management plan.
2. Ask students if they have ever participated in recycling at home, school or a special event. What items did they recycle? How would they define “trash” compared to something that is “recyclable?” As a warm-up activity, have the students complete “Can It Be Recycled?” Student Sheet.
Note: Answers for this exercise may vary. The items that can typically be recycled (Y) are: # 1, 2, 4, 10, 11, 13, 19, 22, 23 and 30. Those items that can sometimes (S) be recycled, depending up on the local market are #3, 5, 7, 8, 12, 17, 20, 21, 24, 28, and 27 may be able to composted or shredded and made available to the residents as compost or mulch. Items #6, 14, 15, 16, 18, 26,29 are not (N) usually recycled. For current information about what can be recycled in community, contact your local public works department or litter prevention and recycling coordinator listed at www.deq.virginia.gov/recycle/contactlist.html. Discuss why the recycling market undergoes changes.
3. Ask students to list once more, a few of the items that can be recycled almost everywhere such as aluminum cans. Discuss the value of aluminum scrap as covered in Background Information. To get a sense of how valuable aluminum is economically and how beneficial recycling it can be environmentally, have students complete the math problems on the “Aluminum Can Dollars and Cents” Sheet.
Answers are:
 1. $24 \text{ cans/lb} \times 15,000 \text{ lb/trailer} = 360,000 \text{ cans/trailer}$
 2. $\$.42 \times 15,000 \text{ lbs} = \6300
 3. $15,000 \text{ lbs/trailer divided by } 30 \text{ lbs/collector} = 500 \text{ can collectors/trailer}$
 4. $24 \text{ cans/lb} \times 800 \text{ lbs/bale} = 19,200 \text{ cans / bale}$
 5. $4 \text{ lbs ore} \times 15,000 \text{ lbs/trailer} = 60,000 \text{ lbs or } 30,000 \text{ tons of ore conserved}$
 6. Local waste authorities, individuals and organizations that collect and bring cans in for recycling will incur the cost of transporting and possibly storing those cans. Whether the people involved are paid as part of their job or volunteer, there time is also has monetary value.
4. **Optional**
 - Review the Life Cycle of an Aluminum Can using a power point presentation at:
<http://www.novelis.com/Recycle/EN/Kids/Fun+Facts/Many+Lives+of+the+Aluminum+Can>
 - Review Lesson 3 of “Going in Cycles: The Life of an Aluminum Can” at:
<http://www.cancentral.com/canc/nontext/lesson3.htm>.Students can complete posters explaining the life cycle of aluminum can or other type of container.
5. Discuss the data on Virginia Statewide Recycling Rate Report sheet and provide the students the opportunity to answer the questions individually or in small groups first before reviewing as a class. The rate is reported as the percentage (by weight) of materials that are collected for recycling

of the total recyclable material in the municipal waste stream. To locate the reported recycling rate for your own community go to www.deq.virginia.gov/recycle/recycle.html. Please note that the recycling rates in this lesson have been adjusted by the Virginia Department of Environmental Quality in accordance with the state regulation. For example, a community's rate may be raised slightly by earning credit for implementing other types of waste management programs. The calculations used to determine those adjustments are beyond the scope of this lesson. As an extension to this activity, students can transfer all or part of this data to a graph of their own design.

Answers:

1. The statewide recycling rate and that of most urban areas increased between 2003 – 2007.
 2. Richmond, Fredericksburg and Lynchburg
 3. Fredericksburg
 4. Northern Virginia and Roanoke
 5. The larger urban areas often have regional solid waste authorities that invest in promotional campaigns and curbside collection programs. Studies show that convenience is a major factor in whether someone recycles or not.
 6. Dramatic increases in recycling could be attributed to many things such as educational programs, new markets opening up for the recycled items or a new and improved collection system.
 7. Decreases in recycling could be attributed to lower prices for the recycled items, changes in funding of the collection program (where it was no longer convenient,) increases in fuel prices in area where people had to drive their items to a recycling center.
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6. If your students were dissatisfied with the recycling rate of their local community, discuss ways that your school may be able to improve those numbers. For information on how to start a school recycling program the Virginia Recycling Association school recycling toolkit is available at: <http://vrarecycle.org/dnnmax.com/SchoolRecyclingToolkit/>. If your school doesn't currently recycle any items, consider starting with aluminum cans from the vending machines, one of the easiest items to recycle as discussed in this lesson.

Assessment:

Students can be evaluated on their contributions to group discussion, their ability to envision the multitude of inputs needed to manufacture products, the accuracy of their research and mathematical calculations and their understanding of the concept that both consumers and local communities have choices in terms of solid waste management.

"Can It Be Recycled?"

Instructions:

- a. Put a "Y" for yes, in front of the items you think can be recycled in every community.
- b. Put a "N" for no, in front of items that you think are not recycled – that are destined to become trash
- c. Put a "S" for sometimes, in front of items you think can be recycled in regions of the state where there is a market, but may not be in your community.

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| ___ 1. White paper (this sheet) | ___ 16. Foam Packing Peanuts |
| ___ 2. Pastel Colored Paper | ___ 17. Paper Egg Cartons |
| ___ 3. Neon Bright Paper | ___ 18. Plastic Egg Cartons |
| ___ 4. Regular White Envelopes | ___ 19. Newspaper |
| ___ 5. Envelopes with Plastic Windows | ___ 20. Paper Shopping Bags |
| ___ 6. Paper Towels | ___ 21. Plastic Shopping Bags |
| ___ 7. Posters | ___ 22. Aluminum Cans |
| ___ 8. Manila File Folders | ___ 23. Glass Bottles |
| ___ 9. Rubber Bands | ___ 24. Plastic Bottles |
| ___ 10. Magazines | ___ 25. Steel and Tin Cans |
| ___ 11. Catalogs less than 1/2" thick | ___ 26. Aluminum Foil |
| ___ 12. Phone Books | ___ 27. yard waste |
| ___ 13. Shredded Paper | ___ 28. construction materials |
| ___ 14. Plastic Bubble Wrap | ___ 29. auto parts |
| ___ 15. Medical Waste | ___ 30. Corrugated Cardboard |

Aluminum Can Dollars and Cents

Background:

Often the aluminum cans at large recycling centers and transfer stations are collected or purchased in (tractor trailer size) trailers. A full trailer holds about 15,000 pounds of loose cans. There are about 24 aluminum cans in a pound. When the trailer is full, it is hauled to a processing plant where the loose cans are pressed into huge 800 pound bales. The bales are either trucked or shipped by train to an aluminum company re-melting plant. Re-melted cans are rolled into new aluminum for new cans. New cans are made of about 50% recycled aluminum. It takes one pound of aluminum to make about 24 aluminum drink cans. For every pound of aluminum that is recycle, four pounds of bauxite ore (from which aluminum is extracted) is conserved.

Just a few years ago, recycled aluminum cans were worth 60 cents a pound. In today's economy, the price has dropped to 24 cents a pound, but is showing signs of rebound. For the purpose of this math exercise, we will use a value of 42 cents per pound, which would be the mid-point between the high price of 2005 and the current level.

Student Questions

1. How many used aluminum cans does it take to fill a full size trailer?
2. What is the value of the aluminum cans in a full trailer?
3. If each can collector brings 30 pounds, how many collectors must visit the center before a trailer is full?
4. How many cans are in one bale?
5. How many pounds of ore would be saved by recycling one trailer full of aluminum cans?
6. What are some of the costs with the front end (first part) of the recycling process?

Virginia Recycling Rate Report

Sweet Union Baptist Church Has the Recycling Spirit!

Despite the ups and downs in the aluminum can market, Sweet Union Baptist Church members have become a recycling force in their northwest Roanoke community. It began in 1999, when the church needed to raise money for their building fund. Twice a month since then, church member, Jesse Powell, has coordinated the collection of an average of 100 pounds of aluminum cans communitywide. The companies willing to purchase the aluminum have changed as well as the amount of money that was earned. The aluminum market hit a high of 67 cents per pound in 2005 and is currently at about 27 cents. Although the church reached the financial goal set back in 1999 and the earnings have dropped, the individuals, families, small businesses and organizations on Mr. Powell's collection route have maintained their enthusiasm for conserving natural resources.

<i>City/Region</i>	<i>2003</i>	<i>2005</i>	<i>2007</i>
Richmond	45%	45.2%	53%
Northern Virginia	32%	32%	35.4%
Hampton Roads	30%	36.1%	43.3%
Roanoke	32%	33.9%	32.9%
Bristol	38%	39.4%	31.4%
Lynchburg	33%	32.8%	40.7%
Fredericksburg	32%	30.6%	46.5%
Northern Shenandoah Valley	48%	26%	35.8%
<i>Your Community</i>			
Statewide Average	30.3%	32.2%	38.5%

*Very few rural counties achieved their goal of at least a 25% recycling rate during these years.

1. What general trends do you note regarding the statewide average recycling rate and those for most urban areas, from 2003 – 2007?
2. Which cities/regions have consistently recycled at a higher rate than the state average?
3. Which city/region increased its recycling rate by the greatest percentage from 2005 to 2007?
4. Which cities/regions showed relatively little change in their recycling rates during the time period?
5. Why do you think urban areas have higher recycling rates than rural counties and that the state legislature set the goals lower for rural areas?
6. How do you think those communities that achieved a dramatic increase in recycling were able to do so?
7. What do you think may have happened in those communities that experienced a sudden drop in recycling?

Helpful Websites:

<http://www.vrarecycles.org> – Virginia Recycling Association

www.deq.virginia.gov/recycle – Virginia Department of Environmental Quality Litter Prevention and Recycling Division

<http://cwmi.css.cornell.edu> – Cornell Waste Management Institute

<http://www.cancentral.com> – Can Manufacturers Institute

<http://www.novelis.com/Recycle> – Novelis (Recycling) Corporation

<http://www.azom.com> – The A to Z of Materials

www.tucsonrecycles.org – City of Tucson Recycling Education Program

www.bottlebill.org – Container Recycling Institute

Portions of this lesson were adapted from *Talking Trash in Tucson: A Middle School Curriculum on Recycling* by City of Tucson Recycling Education Program and *Trash Goes to School* by Cornell Waste Management Institute.

